THE BIOLOGIST

A Quarterly Journal Promoting Research
Interest in the Biological Sciences

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2. Conducts Initiations and Installations as Custodian of the Ritual.

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SCIENCE AND LITERATURE*

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One of the most deeply held convictions of modern educated man is that science and literature are essentially incompatible. In its most exaggerated form this conviction tends to reduce the student of literature in the eyes of the scientist, or the student of science, to the status of a *dilettante*, idly and wastefully pursuing interests which it were better he had put behind him with the things of his youth. On the other hand, held in the same extreme form by the student of letters, it makes of the scientist or embryo scientist a materialistic barbarian — clever it may be — perhaps all too clever — but concerned with occult endeavors which, however beneficial to society as a whole, ultimately drain him of the fine flavor of his humanity. So widespread has this dichotomization become that we are apt to assume it as a condition that always existed and to think that it has perhaps some justification in the nature of learning. To demonstrate that neither of these assumptions is true and to point out the dangers in them to the true autonomy of both the scientist and the man of letters is the burden of the following remarks.

That science and literature were not rigidly separated in the early periods of human culture an examination of the primary literature of any nation will readily demonstrate. Turning naturally to Homer, the well-spring from which all subsequent western literature derives, we read at the very beginning of the first book of the *Iliad* how Chryses, whose daughter had been carried off by Agamemnon, prays to Apollo, the god of the silver bow whose priest he was, to avenge him. And Apollo —

> "Hearkening, wroth in his heart, from the heights of Olympus
>   descended
> Bearing his bow on his shoulder, a close-shut quiver beside it.
> Clanging, rattled and rang on his shoulders the shafts of the godhead,
> Striding along in his wrath, like nightfall fearful advancing.
> Off from the galleys he sat; then loosed an arrow amid them.
> Fearfully came the clang of the bent bow's shivering silver.
> First at the mules, at the swift-footed dogs, he directed his onset,
> But thereafter, discharging his biting missiles against them,
> Men, too, smote he; and aye burned pyres close-crowded of corpses."

You may wonder quite rightly what connection all this has with science. In the modern meaning of science almost nothing. But we must be wary of expecting from a poet a learning which his age does not possess. Science (physics would have been the Greek word) is distinguished from metaphysics in that the former is concerned with explaining or attempting to explain phenomenal mysteries whereas the latter is at grips with noumenal reality. Now Homer living long before Louis Pasteur and the invention of the microscope knew nothing of what modern science knows of infectious diseases and their causes. But he was confronted with a fact. Plagues were a fearful reality of the Homeric world and he gave the best and most scientific explanation of the plague that afflicted the Greek army which his age could offer. It happens that his explanation was wrong but before you smile too contemptously at him you ought to recall (at least it is so rumoured in the world of the humanities where I spent most of my waking hours) that even in modern times the scientific dogmas of one generation are only exploded hypotheses to the next.

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*An address given before the Alpha Omicron Chapter in March 1958.

Or again, to quote from the same poet for he is a very important one, when Odysseus is at last granted permission to leave the island of Calypso the goddess herself provides him with tools to build the raft on which he was to begin his dangerous journey homeward. An axe she brought him "...of bronze, sharpened on both sides, and in it was a beautiful handle of olive wood, securely fastened" and in addition that he might smooth the timbers she brought him a polished adze. Moreover, when he had felled the necessary trees she "...brought him augers; and he bored all the pieces and fitted them to one another, and with pegs and morticings did he hammer it together. Wide as a man well-skilled in carpentry marks out the curve of the hull of a freight-ship, broad of beam, even so wide did Odysseus make his raft. And he set up the deck-beams, bolting them to the close-set ribs, and laboured on; and he finished the raft with long gunwales. In it he set a mast and a yard-arm fitted to it, and furthermore made him a steering-oar wherewith to steer."

Now this is not Homer's idea of pure science as was the case with the passage from the *Iliad*. This is applied science and if you think it is a far cry from this to the applied science of our day which creates upswept fenders and accompanying motors many times as powerful as they need be and many times as wasteful of gasoline as they ought to be, you will be right; but, nevertheless, Homer is here celebrating the art of shipbuilding, which then was and still is a key factor in the problem of the distribution of economic goods.

The expansion of scientific knowledge has proceeded so rapidly in the past two hundred and fifty years and the resultant specialization has been so intense that in the popular mind at least science has cut itself off as completely from philosophy as it has from poetry. Still, less than three centuries ago such was not the case. As late as the renaissance science was still spoken of as "natural" philosophy and the scientific attitude was still basically the same as it had been with the dawn of western thought. What differentiated the natural philosopher in classical as well as in mediaeval and in renaissance times from the modern scientist was that having less wholly technical knowledge he still had room in his thinking for the over-all view. Whereas the modern thinker will almost certainly emphasize analysis, his predecessors stressed synthesis. The latter were not only concerned with the "nature" of the world in which man lived; they were even more concerned with man's place in that world. Now it may surprise you to be told that some of the earliest philosophies of nature (which embraced the finest scientific thinking of which man was then capable) were expressed in poetry. The great Eleatic, Parmenides, was such a poet-scientist. Plato expounds fully the doctrines of Parmenides in two dialogues, one named after the earlier thinker, the *Parmenides*, the other the *Theaetetus*, and it may be that through Plato Parmenides influenced the cosmological thinking of John Milton in *Paradise Lost.* But of all the ancient poets who wrote learnedly on science, the name of the Roman Lucretius must stand first. His poem is entitled *De Rerum Natura*, *Of the Nature of Things*, and it is a mighty work setting forth the atomistic theory of creation. After invoking Venus, the goddess without whom "...nothing comes forth into the shining borders of light, nothing joyous and lovely is made...," he announces that he will discourse "...upon the most high system of heaven and of the gods, and [will] disclose the first beginnings of things — how from these nature makes all things and increases and nourishes them, and into these the same nature again reduces them when dissolved; — which in discussing philosophy we are wont to call matter, and bodies that generate things, and seeds of things, and to entitle the same first bodies, because from them as first elements all things are."

Lucretius' poem is a magnificent but joyless work. For him there are no gods. Chance alone rules. The universe and all things in it are the result of the accidental agglomeration of atoms. It is probably true, as most critics have thought, that he is least a poet when he is painstakingly decribing how generation and corruption take place amidst endless flux, but there is no slightest hint that Lucretius himself felt the incompatability of his scientific subject matter with his poet's art.

I have not included Plato among the Greek poet-scientists, although some would doubtless insist he is pre-eminent among them. I have mentioned his paraphrase of Parmenides in the *Parmenides* and the *Theaetetus*, where his concern with cosmological problems is intense. In the latter dialogue and in his *Republic*, especially in the 10th book of the latter where occurs the famous vision of Er (which Milton certainly knew and utilized in Paradise Lost), he has set down observations upon the universe which are both interesting and profound. Nevertheless, while confessing myself a rank amateur among Platonists, my conviction is that science was actually uncongenial to Plato. He was by nature a philosopher in the exact sense who had a poet's gift of expression. He knew and employed the scientific learning of his age, else he had not been a great philosopher, but science, I think, is never foremost in his affections.

But if I omit Plato from this chronicle, I include a figure who superficially would seem much more difficult to justify, the inevitable

Aristotle. At first glance Aristotle might indeed seem to be the first of the dichotomizing specialists. If ever any man was a scientist by native gift and inclination, Aristotle was he. He had the icy and detached intellect. Lacking Plato's graces of expression he writes a Greek which partly because of the corruption of texts but more largely, probably, because of the concentrated impersonality of the style is thorny to the point of unintelligibility. Moreover, much of his *De Generatione et Corruptione*, *Historia Animalium*, *De Partibus Animalium*, and *De Generatione Animalium* is the distillation of a research scientist in the modern sense. Yet with all that he is the author of what will always remain the basic work on rhetoric and his *Poetics* has earned him a place among the greatest of literary critics. The fact that, despite its fragmentary nature, the *Poetics* provides the starting point for all serious discussions of drama and epic and that in one of its *obiter dicta* the concern of modern lyric poets and their interpreters with metaphor as the basis of their art finds solid support is evidence enough that in this scientist poetry was accepted as a serious humane discipline.

The next major figure whom I would cite as exemplifying the gracious reconciliation of science and poetry is the mediaeval Dante. Like the classical masters on whom he drew so heavily, Dante lived in an age when it was still possible for an educated man to have an adequate grasp of the whole of man's knowledge as it was then constituted and this greatest poet of the middle ages possessed such an encyclopaedic mind. Dante's knowledge of mathematics and astronomy is particularly noteworthy. One of the first impressions the reader of the *Divina Commedia* receives is of being in contact with a poet who has a complete and ordered grasp of the physical world in which the action of his poem transpires. I cite only two examples. In the opening canto of the *Purgatorio* Dante describes the joy he felt when he and Virgil emerged from the darkness and gloom of the infernal regions into the pure air that surrounds the isle of Purgatory.

> To the right hand I turn'd, and fix'd my mind
> On the other pole attentive, where I saw
> Four stars, ne'er seen before save by the ken
> Of our first parents. Heaven of their rays
> Seem's joyous.

This is a curious passage. Of it a 19th century commentator has remarked: "Dante here speaks as a poet, and almost in the spirit of prophesy; or what is more likely, describes the heaven about that pole according to his own invention. In our days the cross composed of four stars, three of the second and one of the first magnitude, serves as a guide to those who sail from Europe to the south; but in the age of Dante these discoveries had not been made." It is not necessary, of course, to attribute this description of the Southern Cross to some mysterious prescience of the poet. From Arabian or other sources the poet doubtless derived his knowledge. But what is pertinent to our discussion is that the precise mind of the poet visualizes with perfect accuracy what the appearance of the southern heavens would have been at the point of his emergence from hell. Analagous in nature are the opening lines of Canto II of the *Purgatorio*:

> Now had the sun to that horizon reach'd
> That covers, with the most exalted point
> Of its meridian circle, Salem's walls;
> And night that opposite to him her orb
> Rounds, from the stream of Ganges issues forth,
> Holding the scales that from her hands are dropt
> When she reigns highest; so that where I was,
> Aurora's white and vermeil-tinctured cheek
> To orange turn'd as she in age increased.

This passage is written in the technical language of the astronomy of time. In it the poet fixes his own position as antipodal to Jerusalem, so that while the sun was setting with respect to that place, which he supposes to be the middle of the inhabited earth, to him it was rising.

But Dante has other scientific interests than astronomy. It is significant, I think, that among the virtuous pagans whom he places in Limbo because they were born before the coming of Our Lord he numbers Dioscorides, author of a famous medical treatise, Hippocrates and Galen, most famous of Greek physicians, Avicenna and Averrhōes, Arabian physicians as well as philosophers, Ptolemy, greatest of Greek astronomers, Democritus, the physician, Euclid, the geometer. In that famous catalogue of exemplary spirits Dante shows little partiality to poets.

After Dante the most renowned of mediaeval poets is, probably, the English Chaucer and Chaucer's interest in science is no less widespread than that of the great Italian. It has been suggested that his familiarity with alchemy (alchemy was the chemistry of the middle ages) may have been due to unhappy personal experience. If so, he was neither the first nor the last poet to fall for get-rich schemes, a weakness, incidentally, not confined to poets alone. Throughout his works he makes free use, too, of medical lore and though his discussions cannot usually be traced to particular authorities they have been shown to conform well to the teachings of the best treatises on medicine and physiognomy of the time. But as with Dante his allusions to astronomy and astrology are so numerous that their elucidation has been a principal work of his commentators. Interestingly he has left a *Treatise on the Astrolabe*, a prose work on astronomy written for the "Lyte Lowys" who was probably his son. There is nothing original about this work. It is a compilation based upon earlier compilations and it is designed for the use of a small boy not yet able to read the Latin originals. But elementary though it is, it indicates the importance Chaucer placed upon science in the general plan of education, as it also reveals his methodical earnestness in intellectual labours.

Nearer to our own time, Sir Philip Sidney, in *An Apology for Poetry*, the most famous work of literary criticism of the Renaissance, insists upon the close interrelationship of poetry and science, indeed of poetry and all learning. "Let learned Greece", he wrote,

> ...in any of her manifold sciences be able to show me one book before Musaeus, Homer, and Hesiod, all three nothing else but poets. Nay, let any history be brought that can say any writers were there before them, if they were not men of the same skill, as Orpheus, Linus, and some other are named, who, having been the first of that country that made pens deliverers of their knowledge to their posterity, may justly challenge to be called their fathers in learning, for not only in time they had this priority (although in itself antiquity be venerable) but went before them, as causes to draw with their charming sweetness the wild untamed wits to an admiration of knowledge, so as Amphion was said to move stones with his poetry to build Thebes, and Orpheus to be listened to by beasts, — indeed stony and beastly people. So among the Romans were Livius Andronicus, and Ennius. So in the Italian languate the first that made it aspire to be a treasure-house of science were the poets Dante, Boccaccio, and Petrarch. So in our English were Gower and Chaucer, after whom, encouraged and elighted with their excellent foregoing, others have followed, to beautify our mother tongue, as well in the same kind as in other arts.
>
> This did so notably show itself, that the philosophers of Greece durst not a long time appear to the world but under the masks of poets. So Thales, Empedocles, and Parmenides sang their natural philosophy in verses; so did Pythagoras and Phocylides their moral counsels; so did Tyrtaeus in war matters, and Solon in matter of policy: or rather, they, being poets, did exercise their delightful vein in those points of highest knowledge, which before them lay hid to the world.

And now I come to Shakespeare and on Shakespeare's science alone might be spent far more time than that allotted for this lecture. As in all other aspects of human endeavor, Shakespeare's interest in science is omnivorous. Let us begin with astronomy (or astrology; it is impossible to separate the two in his era). I suppose the one work of Shakespeare that ought to be called to mind by mention of his interest in astrology is *Romeo and Juliet.* This is the great "star-cross'd" tragedy, an epithet that derives from the Prologue:

> Two households, both alike in dignity,
> In fair Verona, where we lay our scene,
> From ancient grudge break to new mutiny
> Where civil blood makes civil hands unclean.
> From forth the fatal loins of these two foes
> A pair of star-cross'd lovers take their life;
> Whose misadventur'd piteous overthrows
> Doth with their death bury their parents' strife.

"Star-cross'd" for Shakespeare doubtless meant "fatal". He was writing about a pair of lovers, young, handsome, high-born with everything to live for and yet their lives end in tragedy — what Granville Barker has called "a tragedy of mischance."

There are other references in the play to the malign influence of the stars. At the end of the 4th scene of Act I, Romeo remarks to Mercutio:

> I fear, too early: for my mind misgives
> Some consequence yet hanging on the stars
> Shall bitterly begin his fearful date
> With this night's revels . . .

In the opening scene of the final act when Romeo is informed by Bathasar that Juliet is dead, he answers:

> Is it even so? Then I defy you, stars!

And two scenes later in the great grave scene, having slain Paris, he delivers his magnificent farewell speech to Juliet in which occur the words,

> . . . . O here
> Will I set up my everlasting rest,
> And Shake the yoke of inauspicious stars
> From their world-wearied flesh.

It was the fashion a generation ago for Shakespearean scholars to write learned essays to prove that these "star-crossed" references reveal Shakespeare's denial of free will and Providence. This is neither the time nor the place to comment on such arguments in detail. I shall only recall that in a later, more mature play, *All's Well That Ends Well*, Shakespeare puts into the heroine's mouth these words:

> Our remedies oft in ourselves do lie
> Which we ascribe to heaven! the fated sky,
> Gives us free scope; only doth backward pull
> Our slow designs when we ourselves are dull.

And in possibly the most profound of all his plays, *King Lear*, after the Duke of Gloucester has attempted to blame the supposed unfilial conduct of his son Edmund on the late eclipses in the sun and moon, Shakespeare has Gloucester's bastard son Edgar (who is a villain but a most intelligent one) reply in words which, I think, Shakespeare would hardly have disagreed with —

> This is the excellent foppery of the world, that, when we are sick, in fortune, — often the surfeits of our own behaviour — we make guilty of our disasters the sun, the moon, and stars, as if we were villains on necessity, fools by heavenly compulsion, knaves, thieves, and treachers by spherical predominance, drunkards, liars, and adulterers by an enforc'd obedience of planetary influence, and all that we are evil in, by a divine thrusting on. An admirable evasion of whoremaster man, to lay his goatish disposition on the charge of a star!

But Shakespeare has many other scientific interests, among which one of the most compelling is his concern with medicine. One of the surest tests of a poet's interests is the nature of his metaphorical language. Figure or metaphor, the natural language of the poet, may be defined as the attempt to interpret the unknown in terms of the known. This is to say that when the poet writes to give point or concrete objectification to a remote or abstract idea he does so by expressing it in terms of some more common physical, emotional, or intellectual experience. Metaphor being a two-pronged comparison, he will try to illuminate the less in terms of the more tangible. Consequently, when a poet consistently falls back upon particular areas of knowledge for the material of his metaphors, we may be certain that those areas are a very intimate part of his intellectual awareness. In the light of this principle, Shakespeare's concern with medicine was clearly intense. Thus in the early *Henry VI, Pt. 3*, Warwick, hearing of the escape of Edward of York, turns to the young king with the words —

> But let us hence, my sovereign, to provide
> A salve for any sore that may betide,

A little later King Henry, puzzled that his people are turning from him to his rival says,

> My pity hath been balm to heal their wounds.

In Shakespeare's time visitations of the plague, that mysterious affection of the late middle ages and the renaissance, which as we have seen also terrified the Greeks, were a frequent and frightening phenomenon. It was inevitable then that Shakespeare's imagery should abound in references to the dread disease. A modern critic has noted that up to the year 1600 the plague imagery occurs frequently in the comedies and the references are airy, even unfeeling. But after 1600, as though Shakespeare were himself after that date more deeply concerned with death, the plague images have a more sombre tone. Mark Antony in his famous soliloquy over Caesar's dead body cries

> ...this foul deed shall smell above the earth
> With carrion men, groaning for burial.

Ulysses in *Troilus and Cressida* is so

> ...plaguy proud that the death-tokens of it
> Cry 'No recovery'...

Lear in rage and disgust calls his daughter Goneril a "plague-sore". Brutus, the tribune, when he is inciting the people to kill Coriolanus, urges them to pursue him to his house and

> .... pluck him thence;
> Lest his infection, being of catching nature,
> Spread further.

The climax of Bishop Gardiner's indictment of Cranmer in *Henry VIII* is that he is "a pestilence that does infect the land."

These plague images testify sufficiently to the fear which Shakespeare and every man of his time must have felt at the sudden visitation of the disease. But what did Shakespeare think of the efficacy of Elizabethan medical practice? We cannot, of course, be sure because he did not answer that question directly but there is reason to think that Shakespeare, like many intelligent men in later ages, believed that a man's health lay pretty much within his own control. Many of his early figures reflect his curiously modern insistence that we bring about a great deal of our own ill health by ill-regulated living and especially by overeating. It is not hard to imagine Shakespeare concurring with the words he puts into the mouth of the Archbishop of York in *Henry IV, Pt. II*:

> . . . . .we are all diseased
> And with our surfeiting and wanton hours
> Have brought ourselves into a burning fever,
> And we must bleed for it.

The remedy for such overindulgence is clearly defined:

> To diet rank minds sick of happiness
> And purge the obstructions which begin to stop
> Our very veins of life.

Or as Norfolk advises Buckingham in *Henry VIII*:

> Ask God for temperance; that's the appliance only
> Which your disease requires.

But if Shakespeare seems startingly modern in his ideas of the results of overindulgence and the curative power of diet, he is even more modern in his anticipation of mankind's need for mental medicine. You recall Macbeth's despairing plea to the doctor when Lady Macbeth has cracked under her load of guilt:

> Cans't thou not minister to a mind diseased
> Pluck from the memory a rooted sorrow,
> Raze out the written troubles of the brain
> And with some sweet oblivious antidote
> Cleanse the stuff'd bosom of that perilous stuff
> Which weighs upon the heart?

Macbeth is clearly asking for psychiatric treatment for his wife (or was Shakespeare only glancing backward to the confessional?) But this doctor has no couch and being more honest than many practitioners both ancient and modern he can only say:

> Therein the patient
> Must minister to himself.

Whereupon Macbeth replies in temper:

> Throw physic to the dogs; I'll none of it.

One other renaissance poet makes science quite as intimate to his thinking as Shakespeare. He is John Donne who more than any other single influence has shaped modern poetry. There is a reason, I think, for Donne's popularity in our time. The modern poet confronted by a world dominated by mechanical gadgets, a world as unpoetic in the usually accepted sense as any world could be, is drawn to an older poet who could make poetry out of the most unpromising materials. Cosmography, mathematics, medicine, chemistry, astronomy — all was grist for Donne's mill. In one of his most famous love poems where he is trying to suggest the gulf that separates his beloved and himself from ordinary mortals he writes:

> Mov'ing of the earth brings harmes and feares
> Men reckon what it did and meant,
> But trepidation of the spheares
> Though greater farre is innocent.

"Moving of th' earth" in prose means "earthquake", and "trepidation of the spheares" denotes some disorder in the orbits of the heavenly bodies. The trials of ordinary lovers make themselves evident as a quake indicates disorder in our planet, but his beloved and he are likened to the "spheares" whose disturbances are less obvious because less earthy. Strange language for a love poet whom a great critic condemned for "perplexing the minds of the fair sex when he should entertain them with the softnesses of love".

In the same poem occur two other scientific images, among the most famous in all Donne's poetry. This poem was probably addressed to his wife on the occasion of his taking a long journey. Donne is attempting to solace her sorrow at their separation by point out that

> Dull sublunary lovers love
> (Whose soule is sense) cannot admit
> Absence, because it doth remove
> Those things which elemented it.

This is to say that love for most mortals does not rise above the attractions of the flesh and consequently physical separation of the lovers means for them the end of love. But their love, he proceeds, is of a different and higher order —

> But we by a love so much refin'd
> That our selves know not what it is,
> Inter-assured of the mind,
> Care lesse, eyes, lips, and hands to misse.

There follows the first of the scientific figures:

> Our two soules therefore, which are one,
> Though I must goe, endure not yet
> A breach, but an expansion,
> Like gold to ayery thinnesse beate.

Here a simple fact of the physics laboratory, the almost infinite malleability of gold leaf, is used to suggest that for those who love in the spirit physical separation is not really separation at all. Then comes the even more famous compass image.

If they be two, they are two so
As stiffe twin compasses are two,
Thy soule the fixt foot, makes no show
To move but doth if the other doe.

And though it in the center sit
Yet when the other far doth rome
It leaves and hearkens after it,
And growes erect, as that comes home.

Here the simple dividers of our high school geometry classes is made the basis for one of the most beautiful descriptions of conjugal love in all literature. The fidelity of the woman is the fixed foot of the divider. It is her stability which controls the erratic tendencies of the husband and keeps his psychic centrifugalism in perfect orbit about its physical and spiritual axis.

From the high poetry of the renaissance I pass in this survey to consider a comic interlude, the eighteenth century Erasmus Darwin's *The Botanic Garden.* This Darwin was the grandfather of the much more famous Charles Darwin. He sought to combine science and poetry in a far more literal fashion than was good for either discipline with strange results. His specific objective is best described in his introduction to his poem:

> "The general design of the following sheets is to inlist Imagination under the banner of Science; and to lead her votaries from the looser analogies, which dress out the imagery of poetry, to the stricter, ones which form the ratiocination of philosophy. While their particular design is to induce the ingenious to cultivate the knowledge of Botany, by introducing them to the vestibule of that delightful science, and recommending to their attention the immortal works of the celebrated Swedish Naturalist, LINNEUS.
>
> In the first Poem, or Economy of Vegetation, the physiology of Plants is delivered; and the operation of the Elements, as far as they may be supposed to affect the growth of Vegetables. In the second Poem, or Loves of the Plants, the Sexual System of Linneus is explained, with the remarkable properties of many particular plants."

And now for a sample of the poem — for a sample will be enough.

DESCEND, ye hovering Sylphs! aerial Quires,
And sweep with little hands your silver lyres;
With fairy footsteps print your grassy rings,
Ye Gnomes! accordant to the tinkling strings;
While in soft notes I tune to oaten reed

Gay hopes, and amorous sorrows of the mead.—
From giant Oaks, that wave their branches dark,
To the dwarf Moss, that clings upon their bark
What Beaux and Beauties crowd the gaudy groves,
And woo and win their vegetable Loves.
How Snowdrops cold, and blue-eyed Harebels blend
Their tender tears, as o'er the stream they bend;
The lovesick Violet, and the Primrose pale
Bow their sweet heads, and whisper to the gale;
With secret sighs the Virgin Lily droops,
And jealous Cowslips hang their tawny cups.
How the young Rose in beauty's damask pride
Drinks the warm blushes of his bashful bride;
With honey'd lips enamour'd Woodbines meet,
Clasp with fond arms, and mix their kisses sweet.—

Because of the limitation of time I pass over the 19th century with brief mention although the poets of that age were genuinely concerned with science. A book has been written identifying Shelley as a Newton among the poets and of course it is common knowledge that in his Oxford days he combined his enthusiasm for Plato with an almost equal enthusiasm for chemistry. Tennyson's great elegy, *In Memoriam*, records the challenge of the new evolutionary science to the Anglicanism of the time and in Locksley Hall occurs the famous description of the aery navies of the future. Browning, Arnold, James Thomson, Hardy—one can scarcely mention a 19th century poet for whom scientific knowledge is not a profound concern.

But what influence does science have on the poetry of our own time? The answer is inevitable. Just as there has never been an age in which science has been brought so intimately into the lives of so many people, so there has never been an age in which science has so deeply coloured the thoughts of the poets. I have already mentioned the shared interest in science which has drawn modern poets to the metaphysical poets of the 17th century. But no 17th century poet ever attempted to do what the American Hart Crane did in *The Bridge*.

Crane was a young poet who died tragically a quarter of a century ago. It is always difficult to assess the significance of a contemporary. But Crane had one conviction which is responsible for the strength as well as much of the weakness of his poetry. He saw his own age as the machine age which it unquestionably is. He was convinced that the great romance of our day is the romance of man's conquest of the physical universe in which he lives. As a symbol of man's dominance he chose Brooklyn Bridge. Here he saw all of man's technological skills gathered up into one great hymn of triumph—into a magnificent symphony of scientific achievement. And so he wrote his epic, *The Bridge*. It is a difficult poem, not designed for aural reception, but the triumphant beat of his rhythms will, I think, reveal in the stanzas I shall read the proud optimism of the poet in man's triumphant powers:

Through the bound cable strands, the arching path
Upward, veering with light, the flight of strings, —
Taut miles of shuttling moonlight syncopate
The whispered rush, telepathy of wires.
Up the index of night, granite and steel —
Transparent meshes — fleckless the gleaming staves —
Sibylline voices flicker, waveringly stream
As though a god were issue of the strings . . .

And through that cordage, threading with its call
One arc synoptic of all tides below —
Their labyrinthine mouths of history
Pouring reply as though all ships at sea
Complighted in one vibrant breath made cry, —
"Make thy love sure — to weave whose song we ply!"
— From black embankments, moveless soundings hailed,
So seven oceans answer from their dream.

And on, obliquely up bright carrier bars
New octaves trestle the twin monoliths
Beyond whose frosted capes the moon bequeaths
Two worlds of sleep (O arching strands of song!) —
Onward and up the crystal-flooded aisle
White tempest nets file upward, upward ring
With silver terraces the humming spars,
The loft of vision, palladium helm of stars.

It is doubtful whether this is great poetry. But in writing it Crane was observing a truth which scientists and poets alike will disregard at their peril. Science, true science, cannot live without the imaginative vision and the faith which sees beyond the revelations of the laboratory the large and transcendent truths of which these are but remote analogies. Nor can poetry live unless it learns to assimilate to its purpose the most factual, the most arduous, the most exactingly detailed of man's pursuits of phenomenal knowledge. Without this it will be but a beating in the void of luminous wings in vain. The ideal here is always the *whole* man. It is much harder to be a whole man than it was in the age of Homer, or of Dante, or even of Shakespeare. But the pursuit of that wholeness may, by its very difficulty, keep our labours safe from the rancid and disintegrating acids of human pride.

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THE EXTRAORDINARY EEL

Bernard L. Gordon

The ancients regarded the eel as both a sacred fish and the delight of the epicure. Herodotus wrote it was held as a god by the Egyptians being sacred to the Nile. Other Greek classicists proclaimed the eel "the King of fish," "a very goddess" and "chief of the fifty Virgins of Lake Copais."

Oppian, a second century Greek poet relates the following method for capture of eels: "The eeler from a high bank of the river Eretaenus, where the eels are the largest and by far the fattest of all eels, lets down at a turn of the stream some cubit's length of the intestines of a sheep. An eel seizing a bit of it at the nether end tries to drag the whole away. The fisher places his mouth on the long tubular reed attached to near end and blows into the sheep's gut. The gut swells and the eel receiving the air in his mouth swells too and being unable to extricate his teeth from the intestine is hauled out adhering to the inflated gut."

In addition to this pneumatic method of Oppian, other old time methods were employed in the capture of the slippery eel. Stirring up the mud in which they were known to lurk was a common practice. From this activity came the origin for the expression "to fish in muddy waters."

The Romans built large fish ponds for the purpose of raising conger eels which they relished. According to Pliny, one Hirius gave a party at which six thousand conger eels each measuring over a yard in length were placed before his guests. Crassus, another Roman, was the owner of a large conger eel over which he displayed so much affection that when it died he gave it a stately funeral and wept over its grave. When mocked in the Senate by Eneius Domitius Ahenobarbus for having cried at the death of an eel, Crassus scored heavily by retorting that was more than "Old Brazen Beard" had done for any of his numerous deceased wives.

Eels form a distinct order of fishes under the classification *Apodes* which is from the Greek meaning literally without foot in reference to the absence of ventral fins on the elongated belly of the fish. Fish known as eels which include the conger and morays, make up eleven families, fifty-four genera and sub-genera and ninety-six species and sub-species.

One common misbelief held by many people is that the common eel can jar you with an electric shock. This is entirely without foundation. The electric eel, *Electrophorus electricus* is one of the most powerful of electric fishes but it is not an eel. More closely related to the sucker or carp families, the electric eel is elongated, eel-like and found in the rivers of Brazil and Guiana. Some scientists believe that it uses the two electric organs in its tail for protection against alligators. The organs are also used to stun fish so that they can be used for food.

The common eel *Anguilla rostrata* occurs all along our Atlantic coast in the brackish waters of rivers where they meet the sea, also in fresh water ponds, lakes, old wells and quarry holes. The commercial eel fishery of the United States extends from Maine to North Carolina with an annual catch of over a million pounds. Eel fishing on a large scale is generally carried on in or near the mouths of rivers and is sometimes regulated by the individual state's division of fish and game. A few states charge commercial fishermen a small eel fishing fee.

The eel is captured in a variety of ways — traps, eel pots, seines, on set lines and by bobbing for eels.

Undoubtedly every common eel you have ever caught in rivers, bays and ponds on the Atlantic coast was hatched from a microscopic egg 650 to 1,800 feet below the surface of the Sargasso Sea southwest of Bermuda. The eel's method of reproduction has been a classical biological mystery for many centuries. Aristotle in his *Historia Animalium* mentions that eels have no milt or roe and seem to come from the entrails of the earth. Pliny stated that eels reproduce by rubbing themselves against rocks and the scrapings come to life. Von Helmont attributed the birth of eels to the dews of May mornings. Other authorities deduced eels originated from the hairs of horses, the gills of fish, while the renown Izaak Walton insisted upon spontaneous generation.

The procreation of eels remained an unsolved problem until a Danish Biologist named Schmidt unraveled the mystery. As the Director of the Danish Commission for the Exploration of the Sea, Schmidt sailed in 1906 on the first of many expeditions to locate the spawning grounds of the eel. For over fifteen years he towed nets up and down the Atlantic Ocean from Greenland to Puerto Rico and the English Channel to Chesapeake Bay collecting specimens of leptocephali which are the transparent ribbon-like larval stages of eels. He correlated the sizes of the larval forms with their locations and reasoned that the smallest larvae would be the closest to the breeding area. After long and intensive research Johannes Schmidt finally worked out in 1925 that the spawning grounds of the American and European eels are found in the Sargasso Sea in latitudes 20 to 30 degrees north and longitudes 60 to 78 degrees west or about midway between Puerto Rico and Bermuda. He also determined that the spawning beds of the European eel overlapped those of the American eel.

Schmidt did not find the eel's eggs. This discovery is credited to Marie Poland Fish of the Narragansett Marine Laboratory staff who was a member of the *Arcturus* expedition to the Sargasso Sea in 1926. Mrs. Fish determined that three fish eggs attached to a crab shell which was dredged up from the bottom were really the first ripe eel eggs known to science as they were later hatched in the ship's laboratory.

Spawning of the eel begins in late winter or early spring. Mature fat eels from the rivers of North America and Europe set off on their long journey to the Sargasso Sea. On their trip to the spawning grounds they do not feed, in fact, their gut disappears. Other changes also occur in the eel's body. Their eyes grow increasingly bigger until they spread over most of each side of the head. No one has yet determined exactly what the large eyes are for. They cannot be for finding food as they do not eat on their trip back to their birthplace. It is still a mystery whether the parents live or die after they mate, as they are never seen again.

The newborn eels are entirely transparent, about one quarter of an inch long and ribbon shaped. They are called leptocephali until they resemble the adult eel on a miniature scale. The leptocepali drift upward from the depths feeding on microscopic algae, then slowly drifting toward the latitude of Bermuda where a separation takes place. The European larvae head eastward across the Atlantic and the American eels head northeast in the Gulf Stream toward the haunts of their parents. In the brackish river mouths of the east coast the young eels lose their transparency and turn into elvers taking on the coloration and proportions of the adult form.

American eels remain in the leptocephalus stage for about one year while their European cousins take three years to transform into elvers because of their longer homeward journey.

Eels are unique in the fish world by virtue of the fact that they spend most of their lives in fresh water and migrate to the sea to lay their eggs. Because of this characteristic they are called catadromous fish. Catadromous means down running. Eels tend to grow rather slowly; full grown European eels have been found ranging from five to twenty years of age. Dr. H. M. Smith found a female eel traveling down the Potomac River which was in its twelfth year.

When kept in captivity eels are known to have great longevity. There is the celebrated Eel of Ross which was caught as an elver in a small Scottish river in 1895 and kept in an aquarium until it died in 1949, having lived a total of fifty-seven years.

The eel is chiefly a scavenger in food habits, feeding voraciously on small fishes, insects, crayfish and aquatic plants. In addition, eels destroy quantities of marketable fish. Jordan, in 1903, stated that the destruction of shad and herring by eels in the Susquehanna and other Atlantic coast rivers was enormous. He mentions that it was not infrequen that when a gill net would be lifted out, the greater part of the catch consisted simply of heads and backbones; the greatest part of the catch being devoured by myriads of eels in the short time the net was left in.

Eels also consider the spawning shad a special delicacy. Many female shad are found empty at the vent and completely gutted of their ripe ovaries. Sometimes a shad apparently full of roe is found to contain several eels of considerable size. Many gamefish such as the striped bass and bluefish seemingly knowing of the destruction wrought by the eel to their eggs prey voraciously on these snake-like fish.

The common eel generally averages between two and three feet.

Unusually large specimens have been recorded up to four feet in length with a weight of sixteen and a half pounds. As a rule, all eels in the headwaters of large streams are found to be females with males remaining in the mouths of rivers. Male common eels never grow larger than two feet. The American eel tends to have 107 vertebrae in its backbone while the European species has 114. This is the major physical difference between the two groups. Eels are also among the most prolofic of fish with large females releasing between fifteen and twenty million eggs.

During the winter months eels tend to hibernate in the muddy bottom of inlets. Frequently, eels are speared with gigs through holes chopped in the ice. Commercial eel fishermen generally trap their catch in pots set out in river mouths and salt ponds. One man can operate as many as 300 pots, but the average fished is usually about 150 per man. The best bait for the trap include horseshoe crabs, chopped squid, herring and alewives. The catch of eels is usually kept alive in a live car placed at the end of a dock until they are shipped to market. During the Christmas holidays live eels bring a fancy price quite out of proportion to their actual value during the rest of the year due to the custom persons of southern European extraction have of eating eels at Christmas time.

Outside of the yuletide season, the eel is a rare item on American menus. Farmers and city dwellers associate the eel with snakes and tend to shy away from it. Orthodox Jews avoid it because it appears to fit under the precept stated in Deuteronomy . . . . "All that have fins and scales shall ye eat: and whatsoever hath not fins and scales ye may not eat." Although common eels appear slimy and smooth, they have minute scales embedded in their skin.

Because of eels' widespread distribution around the globe, countless recipes have been devised for cooking them. They should be prepared for cooking when freshly caught or when bought alive from the fish dealer. There are two principal methods of skinning an eel, one is by starting from the head, the other from the tail. In the first method you make a shallow incision around the head and grasping the head with a cloth or gloved hand you can pull the skin off with pliers with a rapid outward motion. With the second method you nail the tail to a board and after making a shallow cut around it near the end, you pull the skin out over the head like taking a stocking off over your toes.

Many recipes call for cooking eels in red or white wine and some state that it is better to boil eels in beer than in water. The tastiest eels are the so-called silver eels which are actually the familiar yellow bellied eels which have reached the age for reproduction.

Among the famous continental delicacies are smoked eels. The finest of these come from Holland and Germany. During England's Victorian era one observer wrote the following of London: "From one end to the other the city teems and steams with eels." Not having hot dogs at that time, the people ate hot eels. "Everywhere smoking away, with many a fragrant condiment at hand to make what is in itself palatable more savoury; and this too at so low a rate that for one half-penny a man may fill his stomack with six or seven long pieces."

Eels are delectable fried, stewed, smoked or pickled. Any good sea food cookbook will provide suitable recipes. The following is a recipe for fried eels....Cut a fresh skinned eel into serving portions. Sprinkle well with salt and vinegar and let stand one hour. Wipe the pieces dry and then season to suit taste. Dip the pieces in a beaten egg with cracker crumbs and fry in butter. Serve the tasty dish with a highly seasoned sauce.

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Left to right: Melville H. Hatch, editor; Fred S. Orcutt, Secretary-Treasurer; Henry van der Schalie, Vice-President; Karl F. Lagler, President. Taken in Albuquerque, N. Mex., September 1958.

THE EDITOR SPEAKS

Elsewhere in this issue appears a discussion of "Science and Literature". In it Dr. Moloney brings forward examples of the use of scientific themes and subjects in poetry. The article is of importance because it reminds us that activities as remote as literature and science are sometimes conceived to be are really after all but diverse aspects of an essentially unitary human spirit. As your editor read the paper, the thought occurred that one sufficiently learned might well reverse the field and similarly exhibit poetic concepts in the service of science. As a prime example may be cited the wonderful concluding paragraph of Darwin's "Origin of Species".

"It is interesting to contemplate an entangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent on each other in so complex a manner, have all been produced by laws acting around us. These laws, taken in the largest sense, being Growth with Reproduction; Inheritance which is almost implied by reproduction; Variability from the indirect and direct action of the external conditions of life, and from use and disuse; a Ratio of Increase so high as to lead to a Struggle for Life, and as a consequence to Natural Selection, entailing Divergence of Character and the Extinction of less-improved forms. Thus, from the war of nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows. There is grandeur in this view of life, with its several powers, having been originally breathed into a few forms or into one; and that, while this planet has gone cycling on according to the fixed laws of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved."

* * *

The Biologist is the property of the widely scattered membership of the Phi Sigma Society. In important measure, it is what these members make it. A journal of sorts can be produced without much help from the membership, but, if The Biologist is to be representative of the Society, help is required from the chapters and membership at large. A point made by the Albuquerque Convention was that The Biologist contain more contributions from active members.

Accordingly, chapter officers are urged to send in (1) frequent reports of chapter activities, (2) publishable contributions from active members, and (3) publishable contributions from faculty members and guests. Remember only that it is without the scope of The Biologist to publish original research reports. Nearly everything else of biological interest is in order!

* * *

The attention of chapter officers is directed to the "News from the Chapters". Three of the all too few reports in this issue refer to mimeographed newsletters or other reports put out by the Alpha Eta, Alpha Xi, and Alpha Chi chapters, and it is suggested that the other chapters might emulate these chapters in such an activity. In these days of numerous mimeograph machines, such a newsletter need not be very expensive and may accomplish much in maintaining chapter espirit de corps. When such newsletters are issued, copies should be sent to the editor of The Biologist, to the other National Officers, and to the active chapters.

Left to right: First row—Northey, Fetter, Morin, Bereczky, Butterworth, Holman, Pedigo, Lunt; Second row—Schmitz, Lemert, Clark, Shelkrot, Kemp, Spahr, Lichtenberg; Third row—Keeton, Holliman, Klingensmith, Filkins, McDougall, McArdle; Fourth row—Boatman, Young. Albuquerque, N. Mex., September 1958, Phi Sigma Convention.

THE 1958 ALBUQUERQUE CONVENTION

The Seventeenth National Meeting of the Phi Sigma Society was held at the University of New Mexico in Albuquerque, September 8 to 11, 1958, with the Alpha Nu Chapter serving as host. Local arrangements were in the capable hands of Miss Fritzie Matthews. Meetings were held in the new Biology Building. Delegates were housed in the Womens' and Mens' Dormitories and meals were had in the Mens' Dormitory cafeteria.

The following Council members were present: Dr. Karl F. Lagler, University of Michigan, President; Dr. Henry van der Schalie, University of Michigan, Vice-President; Dr. Fred S. Orcutt, Virginia Polytechnic Institute, Executive Secretary-Treasurer; Dr. Melville H. Hatch, University of Washington, newly appointed Editor of the Biologist.

Delegates were present from 25 of the 36 currently active chapters, as follows:

Beta	University of Michigan	W. Joseph Klingensmith
Kappa	University of Kansas	William T. Northey
Nu	Washington and Jefferson College	Joel W. Shelkrot
Pi	Emory University	Robert A. Pedigo
Rho	University of Illinois	Eugene McArdle
Sigma	University of Florida	J. Alan Holman
Upsilon	Miami University (Ohio)	Charles C. Lemert
Phi	University of New Hampshire	Burr Clark, Jr.
Psi	University of Washington	Edwin S. Boatman
Omega	University of Oklahoma	Dee Keeton
Alpha Alpha	University of Southern California	Bernard B. Butterworth
Alpha Epsilon	University of Pittsburgh	Elizabeth Bereczky
Alpha Eta	Oklahoma State University	James D. Schuh
Alpha Iota	Bucknell University	Mary Emma Fetter
Alpha Kappa	Hunter College	Ingeborg Lichtenberg
Alpha Lambda	University of Utah	Steele R. Lunt
Alpha Nu	University of New Mexico	John Butler
Alpha Xi	University of Rhode Island	Lorraine P. Morin
Alpha Omicron	Marquette University	James Filkins
Alpha Pi	University of Colorado	Eugene H. Schmitz
Alpha Phi	College of Puget Sound	Lary V. Davis
Alpha Psi	Virginia Polytechnic Institute	J. Sandra Spahr
Alpha Omega	University of Georgia	W. Glenn Young
Beta Beta	Florida State University	Rhodes B. Holliman
Beta Delta	University of Virginia	James P. Kemp, Jr.

One alternate, Ken McDougall, Alpha Omicron, was likewise present and participating.

The first get-together of the members of the convention was for a wiener roast picnic supper in the back yard of the home of Miss Fritzie Matthew's, in the northeast corner of Albuquerque. The evening was mild, insects including some large mantids kept flying in, and a delightful convivial atmosphere prevailed.

The convention got down to business the next Tuesday morning in the auditorium of the Biology Building, but only some of the more general and important items of business will be mentioned here. Dr. Potter, newly appointed Chairman of the University of New Mexico's Department of Biology welcomed the delegates and others to the campus.

The Secretary-Treasurer reported that the 36 active chapters have in the last two years elected 1666 new members to a total membership of 24,077. He suggested that delegates urge upon their chapters the desirability of keeping in mind the nomination of honorary members and to make sure that their Council Representative is someone who has a genuine interest in the society. The Council Representative should definitely not direct the policies of the chapter, but should have "know-how" and experience of society and chapter affairs so as to give true continuity to the chapter's activity. This requires that he have a term of at least four years, as provided by the Constitution, and as much more than that as the Chapter sees fit. The Council Representative may be but does not necessarily have to be the Chapter Adviser.

The delegates were instructed to urge upon the officers of their respective chapters the importance of acquainting themselves fully with the details of society and chapter operation as derived from a study of the Society's Constitution and By-Laws, the Ritual Book, the mimeographed annual Bulletin for Chapter Operation, the mimeographed Proceedings of the Convention, and the membership forms.

Vice-President van der Schalie reported that the former Editor of the Biologist, Dr. A. M. Keefe of St. Norbert College, West De Pere, Wisconsin, resigned in May 1957 after having served as editor from 1931 to 1939 and from 1946 to 1957. Vice-President van der Schalie and President Lagler had assumed responsibility for bringing out fall 1957 and spring 1958 issues, and Dr. Melville Hatch, Council Vice-President 1933-1939, has indicated willingness to edit the journal at least for a year or two.

Tuesday afternoon was occupied largely by the reports of delegates. The general pattern of chapter activity is one meeting a month, although several delegates reported semimonthly meetings. The afternoon meeting closed with the appointment of committees on standards, resolutions, the Biologist, auditing, and nominating. The delegates then adjourned and met with their wives at an excellent Mexican dinner at LaPlacitas in Old Town Albuquerque. After dinner the several committees met back in the Biology Building.

The first order of business Wednesday morning was the report of the Nominating Committee, on the basis of which Dr. van der Schalie was unanimously reelected Vice-President for a four-year term. The President and Executive Secretary-Treasurer hold over until 1960.

The committee on the Biologist recommended (1) that the Biologist be continued with a minimum of two issues a year, (2) that contributors from student as well as faculty members be earnestly solicited, (3) that general rather than technical or research articles be favored, (4) that chapter editors stress the general rather than the particular nature of chapter activities — reports that will be helpful to other chapters in organizing their own programs, (5) that lists of non-technical books and book reviews be continued, (6) that issues featuring individual chapters be considered from time to time, (7) that each chapter be careful to distribute the issues to all active and faculty members.

The standards committee urged all chapters to stress individual ability and interest as well as the "B" average requirement, and not to neglect women and undergraduates in selecting new members. The importance of interesting prospective members in the society as early in their college careers as they qualify was especially stressed.

The auditing committee found the books of the society in order and, on the basis of its recommendation, it was voted to refer to the chapters the raising of the initiation fee for faculty members from $4 to $7, making it the same as the present rate for active members.

The Resolutions Committee proposed the following report, which was accepted:

"Greetings are extended to Dr. A. I. Ortenburger, Past President, and to Dr. Laurence H. Snyder, Honorary President, who were unable to attend the convention."

"Appreciation is extended:

1. To the University of New Mexico for the generous use of their campus facilities and particularly to Dr. Edward F. Castetter, Vice-President and Dean of the Graduate School; to Dr. L. S. Potter, Chairman, Department of Biology; and to Mrs. Peggy Ackerman Smith, Chairman, Housing Committee.
2. To Alpha Nu Chapter for their roll as host and especially to Miss Winnifred Matthews for her efficient handling of convention details, and to Mrs. Kenneth C. Matthews for the generous hospitality which she extended to the delegates.
3. To Dr. A. M. Keefe, retiring editor of The Biologist, for his devoted service to Phi Sigma.
4. To National Officers Dr. Karl F. Lagler, President; Dr. Henry van der Schalie, Vice-President; and Dr. Fred S. Orcutt, Executive Secretary-Treasurer for their constant and unselfish services.
5. To Dr. Melville H. Hatch, former national officer, for lending his enthusiasm and support to this convention.
6. To the A.A.A.S. and the A.I.B.S. for their helpful efforts in our behalf."

Invitations for the 1960 Convention were extended by Alpha Phi

(College of Puget Sound) and Psi (University of Washington) jointly; by Alpha Epsilon (University of Pittsburgh), and by Kappa (University of Kansas). Final decision by the Council was deferred.

At a final business session, Wednesday afternoon, the convention authorized Dr. Orcutt to petition the American Institute of Biological Sciences in behalf of the Phi Sigma Society for full membership in the A.I.B.S.; that, to enable this, all future initiates into active membership in Phi Sigma be assessed an extra $1.00 as part of the regular initiation fee to cover the first year of membership in the A.I.B.S.; and that the Constitution and By-Laws of the Phi-Sigma Society be amended so as to legalize this action. This amounts to an increase of $1.00 over the $7.00 fee now in effect. It further is implicit in our request to A.I.B.S. that we seek for any active member the privilege of yearly renewal of membership at $1.00 per year as long as he is an active member and is a graduate student.

This motion was passed as the result of Dr. Orcutt's explanation at length of the nature of the A.I.B.S. and of his negotiations with its Executive Director, Dr. Hiden T. Cox. It involves the recognition by the A.I.B.S. of Phi Sigma as the only recognized biological honor society and of the opportunity offered to the A.I.B.S. of making contact at an early age with future biologists. Its implementation will likewise further enlarge the role of Phi Sigma in being the first contact of the young biologist with professional biology.

This last business meeting of the convention adjourned about 2 P. M. The rest of the afternoon was spent in a tour of the University of New Mexico's campus, including an extremely interesting presentation by three members of the Department of Sociology of "An Enlightened Approach to the Problems of the Pueblo Indians." Thursday was occupied by an all-day field trip by bus. The Santo Domingo Indian Trading Post and Pueblo was visited in the morning. Lunch was had at the Lodge in Los Alamos, 7000 feet in the mountains; and the Bandolier National Monument and its cliff dwellings were visited in the afternoon, with dinner in Santa Fe, the capital of New Mexico.

BOOK NOTICES

Unless otherwise signed, the notices are by the Editor.

The Autobiography of Charles Darwin 1809-1882. With original omissions restored. Edited with appendix and notes by his grand-daughter, Nora Barlow. Collins, London. 1958. 253 pp. 4 portraits.

Charles Darwin. By Ruth Moore. Hutchinson, London. 1957. 208 pp. portrait.

Darwin's Century. Evolution and the Men Who Discovered It. By Loren Eiseley. Doubleday & Co., Inc. New York. 1958. xvii + 378 pp., 4 portraits.

It is seemly that men's thoughts revert to Darwin in 1958, the centennial of the Darwin-Wallace announcement of natural selection, and in 1959, the centennial of "The Origin of Species." In three different ways these three volumes commemorate the event.

Nora Barlow's book adds still another to the extensive but none the less precious collection of original documents relating to her illustrious grandfather. There are the original three volumes of "The Life and Letters", published in 1887, five years after Darwin's death. There are the two volumes of "More Letters" issued in 1903. There are the two volumes of "Family Letters" edited by Darwin's daughter, Henrietta Litchfield, published privately in 1904, with a public edition in 1915. There is the "Foundations of the Origin of Species", issued in 1909 to commemorate the semicentennial of "The Origin" and containing the never-before-published text of the famous essays of 1842 and 1844. There is the original text of Darwin's Beagle diary, edited by Nora Barlow in 1933 and some further Beagle letters by the same editor in 1946. And there is that intriguing "Period Piece", published in 1952 by another grand-daughter, Gwen Raverat, portraying with such delightful humor the doings of the second and third generations of Darwins.

And now we have the full text of the "Autobiography". An expurgated version of this constituted an early chapter in the original "Life and Letters". Interest in the complete text stems two sources: the additional light it throws on Charles Darwin and the sorts of comments that the Darwin family at the time of Darwin's death wished to withhold from the public. The expurgated material consists of personal and not always flattering comments on Darwin's friends and colleagues. The upshot in this reviewer's opinion is largely neither here nor there. More interesting are some of Darwin's comments on religion which were withheld at the explicit request of his widow. Even these do not contain anything very radical by mid-twentieth century standards. But they do show that, close as Charles and Emma Darwin were, Charles' scientific studies had led him to question the current orthodoxy in a way that his wife did not follow. Darwin was the personification of gentleness and mildness, but this did not keep him from following what he believed to be the implications of his findings to their logical conclusion.

The real importance of the separate publication of Darwin's "Autobiography" is that it makes available in a brief 150 pages the best possible introduction to Darwin's life and thought. It is, in a way, perhaps unfortunate that this should be coupled with 75 or 80 pages of materials that will be at best of interest only to the Darwin specialist, like his totally trivial controversy with Samuel Butler. But any light on the great evolutionist is, ultimately, to be thankfully received.

I suppose that as long as books continue to be written, there will be retellings of the Darwin story. Miss Moore's account is competently and delightfully done and I found my interest fagging only in her chapter devoted to explaining natural selection. But the essentials of Miss Moore's story is in the Autobiography, and one can scarcely advise the enquirer after information about Darwin to spend time with secondary sources, when so much primary material is available.

Loren Eiseley is head of the Department of Anthropology at the University of Pennsylvania. His book, "Darwin's Century", is a full bodied history in which there is presented in most vigorous and interesting fashion an account of some of the major and minor expositors of ideas that are involved in Darwinism.

Professor Eiseley's interest is in a history of ideas, but he frequently seems to be bordering an antiquarianism. He discusses at considerable length, for instance William Wells' and Patrick Mathew's anticipations, in 1813 and 1831 respectively, of natural selection, which had no influence, as nearly as can be seen, on the course of intellectual history. I suggest that it was Darwin's perception of the completely trivial nature of these anticipators rather than the fact that he was "not particularly generous" (p. 126) that led him to give them the scant notice that he did. Eiseley speaks of the Wells incident as illustrating "some of the more subtle and elusive aspects in the growth of the Darwinian hypothesis" (p. 121) to which I would rejoin that it has no demonstrable connection in any way with the development of Darwin's views.

It is a theory of the history of ideas that is at issue. Such history must, in the reviewer's opinion, be concerned primarily with causal relationships, not with the putting side by side by the historian of unrelated coincidental events.

The author speaks (p. 4) of "the various streams of thought which ...have had an intricate and autonomous existence ....It is my hope ...to recapture from the fossil world of documents some glimpses of the living shape of thought as it flows, mutates, and transforms itself from age to age." The reviewer is uneasy in the presence of the concept of "streams of thought" having an "autonomous existence". So far as he is concerned thought exists only in individual minds and it has a history only as it passes from mind to mind and influences them.

Eiseley (p. 14) reports that Sir Thomas Browne, "musing over his own palm prints, had discovered that 'which I could never read of nor discover in another'. The wonder of individual variation had struck him. 'Even in things alike there is diversity.' Genetics was as yet unborn but its essence is contained within that simple statement." The reviewer is unimpressed by the connection!

To return again to the Wells affair, Eiseley accuses Darwin of dismissing Wells with the comment "that so far as he could see Wells had applied the idea only to the human races", whereas "Wells had in reality paid attention to animals since he had said that 'amongst men, as well as among other animals, varieties of a greater or less magnitude are constantly occurring.'" (p. 121). What Darwin actually said (Origin of Species, ed. 4, p. xvii) was that Wells "observes, firstly that all animals tend to vary in some degree, and, secondly, that agriculturalists improve their domesticated animals by selection; and then, he adds, but what is done in this latter case 'by art, seems to be done with equal efficacy, though more slowly, by nature, in the formation of varieties of mankind...'" Darwin has pointed out that Wells included "all animals in his account. It was not Darwin but Wells himself who limited the application of the idea to man!

Eiseley is throughout and properly attempting to play the part of the critical historian. If, on occasion, he appears to cut things too fine, that may be an inevitable part of trying to point out more adequately what the actual historical interrelationships were. The whole truth in subtile matters of this sort, perhaps, cannot be looked for on the first time round, and for all its occasional over straining, "Darwins Century" is an important book that all students of the history of evolutionary thinking must study most carefully.

A General Textbook of Entomology. By A. D. Imms. Ninth Edition Revised by O. W. Richards and R. G. Davies. Methuen & Co., Ltd. London. 1957. 886 pp., 608 figs. 75 shillings.

Insects and Mites of Western North America. Revised Edition. By E. O. Essig. Macmillan Co., New York. 1958. 1050 pp. 766 figs. $18.

It is always good to greet old friends. For over thirty years these two books have occupied unique positions on the entomologist's bookshelf, the one as the leading textbook on entomology in English, the other, under the title "Insects of Western North America," the prime reference on the insects of its area.

Since its original appearance in 1925, Imm's work has been kept available through a series of corrected reprints. It is now a pleasure to report that, still within its original scope, the book has been thoroughly revised and brought up to date. There are 200 pages on anatomy and physiology, 50 pages on development and metamorphosis, and 575 pages on the orders on insects. Topics such as paleontology, ecology, and economic entomology are without the scope of the volume.

It is regrettable that the publishers of the revised edition of the "Insects and Mites of Western North America" did not have sufficient faith in the virility of Western entomology to commission Professor Essig to so revise his book that it would do the same for Western Insects in 1958 that the original did in 1926. The publishers state that 59 illustrations have been changed and 100 species added to bring the total to 6317, and some of the scientific names have been changed. In general, however, the book is a corrected edition of the 1926 work. The pagination is the same except for 15 more pages of index. Only a few of the publications on western insects postdating 1926 are referred to and many pages are identical in the two editions. Despite this, the original book was so important that it is still an essential work for the bookshelf of the western entomologist. Whether the changes are important enough to warrant the owner of the first printing in investing in a copy of the 1958 printing is something that each person must decide for himself.

THE CHAPTERS

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Editor: Dixon Hubbard, Animal Husbandry Department
Student Assembly
Repr.: Kenneth Dunkelgood

In the spring of 1958, Alpha Eta issued a five mimeographed page Newsletter. It details the activities of the Chapter for the current year. The programs of the year's 17 meetings are reviewed and the 97 active and 67 faculty members are listed.

Alpha Iota

Bucknell University, Lewisburg, Pa.

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Vice-President: Charles James Favino Dr. Roger H. Bowman,
Secr.-Editor: Charles James Favino Department of Biology
Treasurer: Mary Emma Fetter

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Vice-President: Barbara Gibgot, 1295 Sheridan Ave., New York 56
Secretary: Lillian Bird, 274 Conner Place, New York 56
Treasurer: Barbara Doonan, 4118 Bruner Ave., Bronx 66, N. Y.

Alpha Lambda

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Vice-President: Steele R. Lunt 203 Biology Building
Secr.-Treas.: Jo Ann Sessions
Editor: Clifford H. Anderson

Alpha Mu

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President: Chester A. Peek, Department of Botany
Vice-President: Floyd M. Stout, Department of Dairy and Animal Husbandry
Secretary: Probaker D. Lotlikar, Department of Agric. Chem.
Treasurer: Hugh P. Stanley, Department of Zoology
Editor: Elisha S. Tikasingh, Department of Zoology

Alpha Nu

University of New Mexico, Albuquerque

President: John Molhenrich, Department of Biology
Vice-President: John Butler, Department of Biology
Secretary: Jeanne Jordan, Department of Biology
Treasurer: Serafin Ramone, Department of Biology

Alpha Xi

University of Rhode Island, Kingston, Rhode Island

President: Lorraine Morin, Alpha Chi Omega House
Vice-President: William Fines, Horticulture Dept., Woshburn Hall
Secretary: Linda Tedrow, Chi Omega House
Treasurer: Calden Collins, Butterfield Hall
Editor: Edward Allen, Butterfield Hall

Under date of June 1958, the Alpha Xi Chapter has issued an attractive 39 mimeographed page magazine called "The Cell". The cover shows a basking shark lying on a lot of menhaden fish. The magazine reviews the current activities of the Alpha Xi Chapter., of eight departments participating in biological work at the University, and of the Narragansett Marine Laboratory. Among the "contributions" in The Cell may be noted a list of the mammals of Rhode Island together with some of their tick parasites by K. E. Hyland, Jr., and articles on "Psychosomatic Aspects of Peptic Ulcers" by Richard Carvalho, "Observations on the Behavior of Striped Bass *(Roccus saxitilis)* in the Charlestown Beachway Area" by Anthony Chatowsky, and "The Extraordinary Eel" by Bernard L. Gordon.

Alpha Omicron

Marquette University, Milwaukee, Wisc.

President: James Filkins, 1940 15th, Milwaukee 4
Vice-President: Kenneth McDougall, 1311 W. Kilbourn, Milwaukee 3
Secretary: Margaret O'Hara, 612 N. 15th, Milwaukee 3
Corres. Sec.: Barbara Brigham, 3311 W. Highland Blvd., Milwaukee 8
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University of Colorado, Boulder

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Editor: Alvin M. Earle, Department of Biology

Alpha Phi

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Alpha Chi

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Vice-President: Mrs. Cecilia V. Zamora, Department of Botany
Secretary: Sonia S. Narvas, College of Pharmacy
Corr. Secr.: Mrs. Virginia S. Carino, Department of Zoology
Treasurer: Angelina Belisario, College of Pharmacy
Editor: Magdalena Cantoria, College of Pharmacy

The third annual issue of Alpha Chi's "Science Bulletin" was issued March 12, 1958, the date when Alpha Chi was installed in 1949. This 32 page mimeographed bulletin reviews the activities of the chapter, lists the chapter's 130 active, faculty, and honorary members, the past and present officers of the chapter, and the recipients of the annual Phi Sigma awards. The longest articles are a seven page discussion of the "Activities of the Marine Fisheries Biology Unit of the Bureau of Fisheries" by Inocencio A. Ronquillo and "The Program of the National Science Foundation in the United States" by Edward M. Palmquist.

Alpha Psi

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Editor: Ina Jones, Department of Botany

Beta Alpha

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Patterson Hall

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Treasurer: Robert T. Brobst, 212 Frear Labs.
Editor: Ruth E. Ott, 299 Mc Elwain Hall

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Vice-President: Robert Rhyne, Department of Psychology
Secretary: Muriel Beuschlein, Department of Biology
Treasurer: James Campbell, Department of Psychology
Editor: Rose Mary Johnson, Department of Biology

Members of the Convention, Albuquerque, N. Mex., September 1958.

THE BIOLOGIST

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THE COUNCIL

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EDITOR: Dr. Melville H. Hatch, Zoology Department, University of Washington, Seattle, Washington

MILE POSTS

1915	March 17, Alpha Chapter organized, Ohio State University, Columbus.
1916	May, Central Governing Body organized, "Biologist" first issued.
1924	December, First National Meeting, Constitution revised, Washington, D. C.
1925	December, Second National Meeting, Kansas City.
1926	December, Third National Meeting, Philadelphia.
1928	December, Fourth National Meeting, New York, Coat-of-arms adopted.
1930	January, Council Meeting, Ritual revised, Norman, Okla. December, Fifth National Meeting, Cleveland.
1931	Phi Sigma Letters Registered, U. S. Patent Office.
1933	June, Sixth National Meeting, Chicago.
1935	December, Seventh National Meeting, St. Louis.
1937	December, Eighth National Meeting, Indianapolis.
1939	December, Ninth National Meeting, Silver Anniversary, Ohio State University, Columbus.
1941	December, Tenth National Meeting, Dallas, Texas.
1946	December, Eleventh National Meeting, Boston, Mass.
1948	December, Twelfth Meeting, Albuquerque, N. Mex.
1950	December, Thirteenth Meeting, Denver and Boulder, Colo.
1952	December, Fourteenth Meeting, St. Louis, Mo.
1954	September, Fifteenth Meeting, Gainesville, Fla.
1956	September, Sixteenth Meeting, Ann Arbor, Mich.
1958	September, Seventeenth Meeting, Albuquerque, N. Mex.

Phi Sigma is a Member of the Association of College Honor Societies, and Associate Member of both the A.A.A.S. and the A.I.B.S.

CHAPTERS FOUNDED

ALPHA — Ohio State University, Columbus, Ohio, 17 March 1915.

BETA — University of Michigan, Ann Arbor, Michigan, 3 June 1916.

GAMMA — North Dakota Agricultural College, Fargo, North Dakota (1916).

DELTA — University of Maine, Orono, Maine, 27 January 1917.

EPSILON — University of Denver, Denver, Colorado, 5 March 1917.

ZETA — University of Wisconsin, Madison, Wisconsin, 30 May 1917.

ETA — University of Akron, Akron, Ohio, 20 April 1921.

THETA — Michigan State College, Lansing, Michigan, 9 April 1921.

IOTA — Washington University, St. Louis, Missouri, 28 May 1921.

KAPPA — University of Kansas, Lawrence, Kansas, 31 May 1921.

LAMBDA — University of Montana, Missoula, Montana, 4 May 1921.

MU — University of California, Berkeley, California, 27 April 1922.

NU — Washington and Jefferson College, Washington, Pennsylvania, 11 May 1922.

XI — University of Nebraska, Lincoln, Nebraska, 3 May 1924.

OMICRON — University of North Dakota, Grand Forks, North Dakota, 26 May 1924.

PI — Emory University, Georgia, 3 January 1925.

RHO — University of Illinois, Urbana, Illinois, 28 March 1925.

SIGMA — University of Florida, Gainesville, Florida, 4 December 1925.

TAU — Duke University, Durham, North Carolina, 4 March 1926.

UPSILON — Miami University, Oxford, Ohio, 7 May 1926.

PHI — University of New Hampshire, Durham, New Hampshire, 21 May 1926.

CHI — Montana State College, Bozeman, Montana, 11 February 1927.

PSI — University of Washington, Seattle, Washington, 7 April 1928.

OMEGA — University of Oklahoma, Norman, Oklahoma, 24 March 1928.

ALPHA ALPHA — University of Southern California, Los Angeles, California, 17 May 1928.

ALPHA BETA — Mount Union College, Alliance, Ohio, 17 May 1928.

ALPHA GAMMA — University of South Dakota, Vermillion, South Dakota, 15 May 1928.

ALPHA DELTA — Lawrence College, Appleton, Wisconsin, 17 March 1929.

ALPHA EPSILON — University of Pittsburgh, Pittsburgh, Pennsylvania, 23 March 1929.

ALPHA ZETA — College of William and Mary, Williamsburg, Virginia, 19 April 1930.

ALPHA ETA — Oklahoma State University, Stillwater, Oklahoma, 13 March 1930.

ALPHA THETA — State College of Washington, Pullman, Washington, May 1930.

ALPHA IOTA — Bucknell University, Lewisburg, Pennsylvania, 9 January 1932.

ALPHA KAPPA — Hunter College, New York City, 8 January 1932.

ALPHA LAMBDA — University of Utah, Salt Lake City, Utah, 13 February 1932.

ALPHA MU — University and State College of Oregon, Eugene-Portland-Corvallis, Oregon, 18 November 1933.

ALPHA NU — University of New Mexico, Albuquerque, New Mexico, 21 April 1935.

ALPHA XI — University of Rhode Island, Kingston, Rhode Island, 17 May 1935.

ALPHA OMICRON — Marquette University, Milwaukee, Wisconsin, 18 June 1938.

ALPHA PI — University of Colorado, Boulder, Colorado, 24 May 1941.

ALPHA RHO — University of Arkansas, Fayetteville, Arkansas, 23 May 1945.

ALPHA SIGMA — University of Texas, Austin, Texas, 2 February 1946.

ALPHA TAU — National University of Mexico, Mexico, D.F., 7 April 1947.

ALPHA UPSILON — University of California at Los Angeles, California, 17 May 1947.

ALPHA PHI — College of Puget Sound, Tacoma, Washington, 28 February 1948.

ALPHA CHI — University of the Philippines, Manila, Luzon, P.I., 12 March 1949.

ALPHA PSI — Virginia Polytechnic Institute, Blacksburg, Virginia, 24 May 1949.

ALPHA OMEGA — University of Georgia, Athens, Georgia, 17 May 1951.

BETA ALPHA — Pennsylvania State Univ., State College, Pennsylvania, 26 May 1955.

BETA BETA — Florida State University, Tallahassee, Florida, 18 February 1956.

BETA GAMMA — Long Island University, Brooklyn, N. Y., 27 April 1957.

BETA DELTA — University of Virginia, Charlottsville, Virginia, 22 March 1958